

2. FLUX CHAMBER UNIT

The flux chamber unit is a trailer-portable solar powered apparatus designed for continuous operation in the field, as shown in the photograph in Figure 3. The unit is equipped with a standard U.S. Environmental Protection Agency (EPA) flux chamber assembly that is placed on the soil surface, as shown in the photograph in Figure 4. Data (i.e., flow rates, barometric pressure, and carbon dioxide [CO₂] concentrations) are logged at regular intervals by a Campbell Scientific 23X datalogger, which records battery voltage and temperature measurements at various locations in the monitoring system. As the name implies, data from the flux chamber unit are used to obtain flux values of CO₂ emanating from soil. Carbon dioxide was the tracer gas chosen for this study because it is a common gas that is widely distributed, and because CO₂ concentrations are easily tracked in real time using infrared sensors.

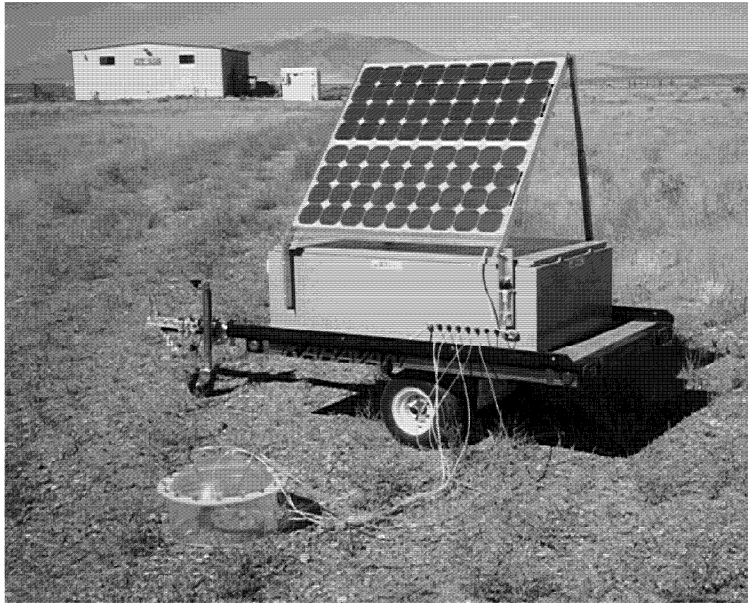


Figure 3. Flux chamber unit.

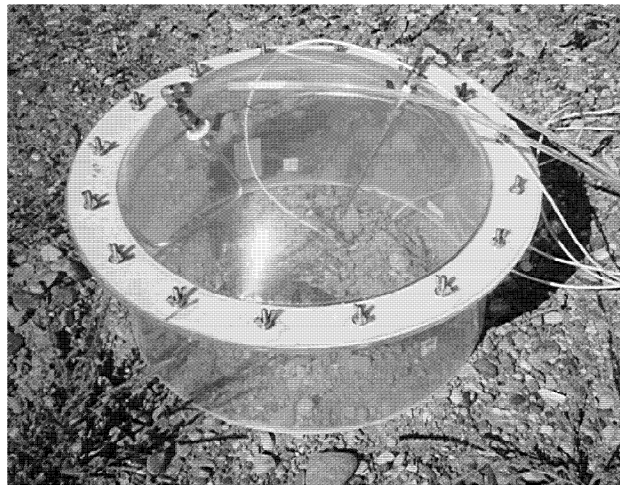


Figure 4. U.S. Environmental Protection Agency flux chamber.

2.1 Unit Operation

A schematic of the flux chamber system flow can be seen in Figure 5. Filtered sweep air (i.e., ambient air) is drawn through a water trap and filtered before flowing through an infrared CO₂ sensor. This air then continues through another filter, a pump, flow adjustment needle valve, and a flow meter before entering the flux chamber. In operation, the sweep air flow is set several times higher than the sample air flow to prevent over pressurization of the flux chamber. A vent allows excess air to escape. Sample air is then pumped from the flux chamber through a water trap and filtered before passing through a second infrared CO₂ sensor. The sample air then travels through a second filter, a pump, flow adjustment needle valve, and flow meter before exiting the system. Data for this operation, including battery voltage, temperatures, flow rates, barometric pressure, and CO₂ concentrations, are logged periodically by a Campbell Scientific 23X datalogger.

2.2 Carbon Dioxide Sensor Calibration

The manufacturer of the CO₂ sensors, Vaisala, and personnel at the INEEL calibration laboratory determined that for the purposes of this investigation, a relative calibration could be conducted for the two sensors used in the study. Rather than absolute CO₂ concentrations, only a difference in concentration was needed from the infrared sensors. Therefore, because the sensor tolerances are linear, the sensors were calibrated relative to each other by collecting 690 respective data points for ambient air conditions over the course of 5 days. As a result, it was found that the infrared CO₂ sensors consistently produced results within 2% of each other.

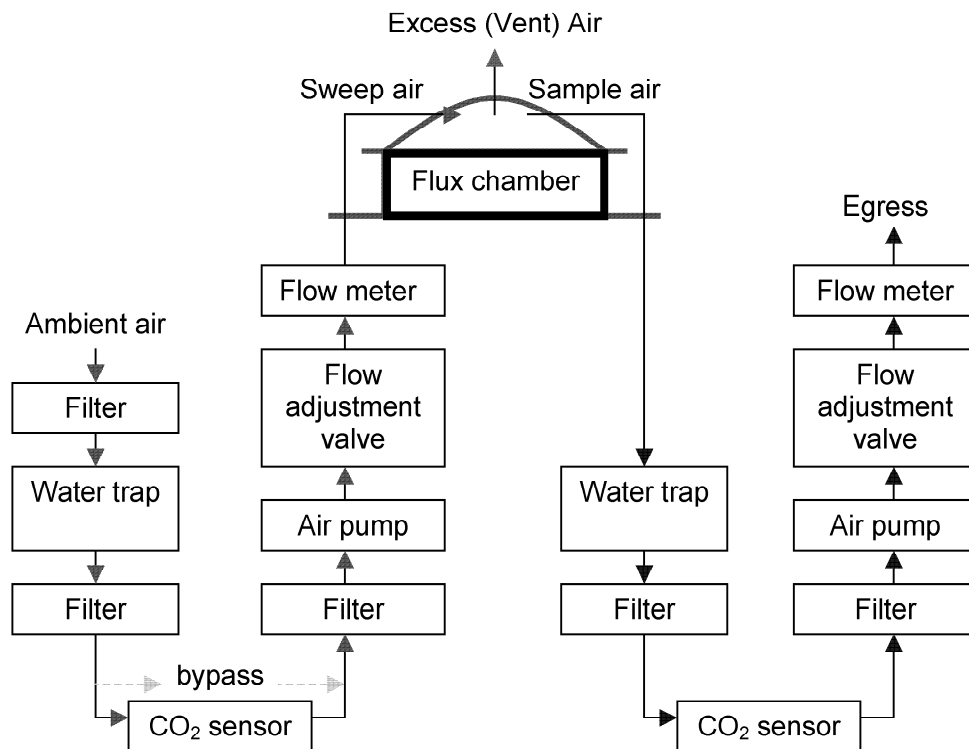


Figure 5. Schematic representation of flux chamber unit operation.